

# Delta V Biomechanics

*Expertise in Medicine and Engineering*



## Elizabeth H. Raphael, M.D.

*Principal Engineer*

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### Specialized Professional Competence

Emergency medicine, biomechanics, vehicular injury analysis, accident reconstruction, restraint system analysis, automotive crash worthiness, occupant kinematics, and computer analysis of human motion.

### Education

M.D. Wayne State University School of Medicine, Detroit, MI

S.B. Mechanical Engineering, Massachusetts Institute of Technology, Cambridge, MA

### Experience

*Principal Engineer*, Delta V Biomechanics, Inc.

*Managing Engineer*, Piziali and Associates, Inc.

*Clinical Associate Professor*, Department of Surgery, Stanford University School of Medicine

*Attending Emergency Physician*, Stanford University Hospital

*Attending Emergency Physician*, Detroit Medical Center

*Assistant Professor (Clinician Educator)*, Wayne State University School of Medicine

*Locum Tenens Emergency Physician*, Munson Medical Center

*Resident Physician*, Emergency Medicine, Wayne State University

*Research Engineer*, Department of Neurosurgery, Henry Ford Hospital

*Researcher*, Department of Orthopedic Surgery, Massachusetts General Hospital

*Engineering Externship*, Quality Assurance Department, Martin Marietta Aerospace

### Licenses and Board Certifications

1997 Licensed Physician in California

1995 Fellow of the American College of Emergency Physicians

1994 Certified Instructor of Advanced Cardiac Life Support

1993 Board Certification in Emergency Medicine, recertified 2003, 2013

1990 National Boards passed

1989 Certified Provider of Advanced Cardiac Life Support

1989 Certified Provider of Advanced Trauma Life Support

### Awards

2000 Society of Academic Emergency Medicine, Regional CPC Award

1987 American Heart Association, for research of aneurysm clips

1987 Henry Ford Hospital, scholarship for neurosurgery research

1984 Wunsch Foundation Silent Hoist and Crane Company Award, for an outstanding academic design project to dispose of biochemical waste

1984 The Estus H. Magoon Scholarship, for outstanding woman student at Massachusetts Institute of Technology

### **Committee Appointments**

Association for the Advancement of Automotive Medicine Scientific Program Committee  
Association for the Advancement of Automotive Medicine Board of Directors  
Detroit Receiving Hospital Emergency Department Domestic Violence Reduction Committee  
Wayne County Medical Society Task Force on Violence  
Michigan Partnership for the Prevention of Gun Violence  
Detroit Receiving Hospital Injury Prevention Committee  
Crittenton Hospital Emergency Department Review Committee

### **Professional Memberships**

American College of Emergency Medicine (ACEP)  
Association for the Advancement of Automotive Medicine (AAAM)  
Society of Academic Emergency Medicine (SAEM)  
Society of Automotive Engineers (SAE)

### **Selected Publications and Presentations**

Keynote Speaker, "CSI: Crash Scene Investigations," Society for Academic Emergency Medicine Midwest Regional, Ford Field, Detroit, MI, September 11, 2014.

Hovey, C.B.; Raphael E. H.; and Xu H.Z., "Validation of Occupant Trajectory Model using the Ford Expedition Dolly Rollover Experimental Test Data," *Society of Automotive Engineers International Congress and Exposition Paper No. 2013-01-0472*, Detroit, MI, April 16-18, 2013.

Invited Lecture, "Recent Biomechanical Analyses Complicated by Obesity," University of Virginia Center for Applied Biomechanics, Charlottesville, VA, March 14, 2012.

Grand Rounds, "Biomechanics and Mechanism of Injury," University of Virginia Emergency Medicine Conference Series, Charlottesville, VA, March 14, 2012.

Invited Lecture, "Biomechanics, Fracture Mechanics and Mechanism of Injury," Stanford University Emergency Medicine Trauma Series, Stanford, CA, March 9, 2011.

Lecture, "Drowning, Near-Drowning and Submersion Injury," Emergency Residents Conference, Stanford University, Stanford, CA November 7, 2010.

Invited Lecture, "Automotive Trauma," Emergency Nurses Association Meeting, Palo Alto, CA, September 16, 2010.

Director, Biomechanics Course, Association for the Advancement of Automotive Medicine, 52<sup>nd</sup> Annual Conference, San Diego, CA October 4-5, 2008.

Piziali, R. L.; Fox, J. C.; Girvan, D. S.; Raphael, E. H., and Ridenour, J., "A Review and Analysis of the Performance of Laminated Side Glazing in Rollover Accidents," *Society of Automotive Engineers International Congress and Exposition Paper No. 2007-01-1166*, Detroit, MI, April 16-19, 2007.

Raphael, E.; Piziali, R.; Le, H.; Hinger, J.; Cooper, E., and Croteau, J., "Physical Evidence Associated With Seatbelt Entanglement During A Collision," *Society of Automotive Engineers International Congress and Exposition, Paper No. 2007-01-1501*, Detroit, MI, April 16-19, 2007.

Invited Lecture, "Rollover Motor Vehicle Crash Injury Patterns", Emergency Medicine Conference Series, Wayne State University, Detroit MI, April 19, 2007.

Invited Lecture, "Rollover Motor Vehicle Crashes," *Emergencies in Medicine*, 24<sup>th</sup> Edition, sponsored by the Michigan Chapter of the American College of Emergency Physicians, Park City, UT, March 3, 2006.

Symposium, *Traffic Collision Types and Associated Injuries*, 49<sup>th</sup> Annual Conference, Association for the Advancement of Automotive Medicine, Cambridge, MA, September 11, 2005.

Invited Lecture, "Motor Vehicle Crash Injury Patterns," *Emergencies in Medicine* 23<sup>rd</sup> Edition, sponsored by the Michigan Chapter of the American College of Emergency Physicians, Park City, UT, March 8, 2005.

Invited Lecture, "Crash Scene Investigations: The Real CSI," 52<sup>nd</sup> Annual Detroit Trauma Symposium, sponsored by Wayne State University School of Medicine, Dearborn, MI, November 11, 2004.

Invited Lecture, "Crash Scene Investigations: The Real CSI," Emergency Medicine Conference Series, Wayne State University, Detroit, MI, November 11, 2004.

Invited Lecture, "Motor Vehicle Crash Injury Patterns," 22<sup>nd</sup> Annual *Emergencies in Medicine* Conference, sponsored by Wayne State University, Park City, Utah, March 5, 2004.

Stanford Winter Semester Lecture, "Biomechanics: Understanding the Human Machine (ME 01)," Stanford University, Stanford CA, Jan. 7 - March 11, 2002.

UC Berkeley Extension Course, "Biomechanics for Scientists and Engineers," University of California at Berkeley (San Francisco Center), CA, November 2001.

Invited Presentation, "Occupant Kinematics and Injury Biomechanics in Rollover Accidents, American Society of Mechanical Engineers, San Francisco Section Meeting, October 2001.

Lecture, "Mechanism of Injury", San Mateo County Field Care Audit, Stanford University, Stanford, CA, February 21, 2001.

Lecture, "Mechanism of Injury - Did you Get T-boned to the Hip Bone?", Thirteenth Annual Trauma Symposium, Stanford Hospital and Clinics, Stanford, CA, July 24-25<sup>th</sup>, 2000.

Stanford Summer Semester Course: Biomechanics: Understanding The Human Machine (ME 01), Stanford, CA, June 19 - July 24, 2000.

Lecture, Mechanism of Injury: The Key to Trauma Care, Stanford Emergency Medicine Symposium, Kauai, HI, March 31, 2000.

Orthopedic Workshop: Splinting and Casting, Joint Reductions, Injections and Aspirations, Stanford Emergency Medicine Symposium, Kauai, HI, March 31, 2000.

Lecture, Orthopedic Emergencies, Stanford Medical Student Lecture Series, Stanford, CA, November 3, 1999.

"Anesthetic Methods for Reduction of Acute Shoulder Dislocations: A Prospective Randomized Study Comparing Intraarticular Lidocaine With Intravenous Analgesia and Sedation," *American Journal of Emergency Medicine*, Vol. 17, Number 6, pp. 560-570, October 1999.

Lecture, Abdominal Pain in the Emergency Department, Stanford Emergency Medicine Resident Orientation, Stanford, CA, July 13, 1999.

Grand Rounds Presenter, Motor Vehicle Crashes During Pregnancy, Stanford OB/GYN Department, Stanford, CA, May 5, 1999.

Lecture, Pedestrian Motor Vehicle Collisions, Stanford Emergency Medicine Conference Series, Stanford, CA, January 27, 1999.

Lecture, Biomechanics of Knee Injuries, Stanford Emergency Medicine Conference Series, Santa Clara, CA, September 16, 1998.

Grand Rounds Presenter, Biomechanics of Car Crashes, Stanford Emergency Medicine Conference Series, Stanford, CA, September 9, 1998.

Lecture, Abdominal Pain in the Emergency Department, Emergency Medicine Resident Orientation, Stanford, CA, July 9, 1998.

Lecture, Biomechanics of Car Crashes, Stanford Trauma Symposium Stanford, CA, October 29, 1997.

Lecture, Dive Medicine, Emergency Medicine Conference Series, Wayne State University, Detroit, MI, August 29, 1996.

Presenter, Intra-articular Lidocaine versus Intravenous Analgesia and Sedation for the Reduction of Acute Anterior Shoulder Dislocations, Michigan Emergency Assembly, Traverse City, MI, July 23, 1996.

Discussant, Case Presentation Competition, Society for Academic Emergency Medicine, Denver, CO, May 4, 1996.

Lecture, Biomechanics, Emergency Medicine Conference Series, Grace Hospital, Detroit, MI, April 25, 1996.

Testified, Michigan State House of Representatives, Transportation Committee, Lansing, MI, February 1, 1996.

Testified, Michigan State House of Representatives, Committee of Downriver Representatives, Ecorse, MI, January 29, 1996.

Lecture, Biomechanics, Emergency Medicine Conference Series, Wayne State University, Detroit, MI, November 30, 1995.

Faculty, Medicine for Engineering, seminar linking medicine and engineering, 39th annual conference, Assoc. for the Advancement of Automotive Medicine, Chicago, IL, October 15, 1995.

Testified, Michigan State House of Representatives, Republican Task Force for Traffic Safety, Warren, MI, May 28, 1995.

Discussant, Case Presentation Competition, Society of Academic Emergency Medicine, San Antonio, TX, May 1995.

Lecture, Focus on Neurology, Nursing Trauma Conference, Crittenton Hospital, Rochester, MI, January 27, 1995.

In Vitro Measurement of Micromotion Between an Artificial Hip Joint and the Host Bone, Bachelor's Thesis, MIT, 1985.

Residual Stresses and the Effects of Preferred Grain Orientation on Aluminum 2219 and its Stress Acoustic Constant, Presented at the American Institute of Aeronautical and Astronautical Engineers Symposium, 1984.

### **Stanford University Courses Taught**

#### 2015-2016 Spring

EMed 280-23 (47863) Early Clinical Experience in Surgery  
EMed 370-23 (47897) Medical Scholars Research

#### 2015-2016 Winter

EMed 199-23 (56710) Undergraduate Research  
EMed 370-23 (56745) Medical Scholars Research  
EMed 280-23 (56779) Early Clinical Experience in Surgery

#### 2015-2016 Autumn

Surg 199-86 (26410) Undergraduate Research  
EMed 280-86 (26417) Early Clinical Experience in Surgery  
Surg 299-86 (26424) Directed Reading  
Surg 370-86 (26431) Medical Scholars Research  
Surg 399-86 (26438) Graduate Research

2014-2015 Spring

Surg 199-89 (29120) Undergraduate Research  
Surg 280-88 (29113) Early Clinical Experience in Surgery  
Surg 370-88 (29106) Medical Scholars Research  
Surg 399-88 (29099) Graduate Research

2014-2015 Winter

Surg 199-89 (29964) Undergraduate Research  
Surg 299-88 (28957) Directed Reading  
Surg 370-88 (28950) Medical Scholars Research  
Surg 399-88 (28943) Graduate Research

2014-2015 Autumn

Surg 199-86 (9720) Undergraduate Research  
Surg 280-86 (9727) Early Clinical Experience in Surgery  
Surg 299-86 (9734) Directed Reading  
Surg 370-86 (9741) Medical Scholars Research  
Surg 399-86 (9748) Graduate Research

2013-2014 Spring

Surg 199-89 (56527) Undergraduate Research  
Surg 280-88 (56513) Early Clinical Experience in Surgery  
Surg 370-88 (56499) Medical Scholars Research  
Surg 399-88 (56485) Graduate Research

2013-2014 Winter

Surg 199-89 (56254) Undergraduate Research  
Surg 299-88 (56240) Directed Reading  
Surg 370-88 (56226) Medical Scholars Research  
Surg 399-88 (56212) Graduate Research

2013-2014 Autumn

Surg 199-86 (56147) Undergraduate Research  
Surg 280-86 (56161) Early Clinical Experience in Surgery  
Surg 299-86 (56175) Directed Reading  
Surg 370-86 (56189) Medical Scholars Research  
Surg 399-86 (56203) Graduate Research

2012-2013 Spring

Surg 199-89 (57413) Undergraduate Research  
Surg 280-88 (57406) Early Clinical Experience in Surgery  
Surg 370-88 (57399) Medical Scholars Research  
Surg 399-88 (57392) Graduate Research

2012-2013 Winter

Surg 199-89 (56926) Undergraduate Research  
Surg 299-88 (56919) Directed Reading  
Surg 370-88 (56912) Medical Scholars Research  
Surg 399-88 (56905) Graduate Research

2012-2013 Autumn

Surg 199-86 (59601) Undergraduate Research  
Surg 280-86 (59608) Early Clinical Experience in Surgery  
Surg 299-86 (59615) Directed Reading  
Surg 370-86 (59622) Medical Scholars Research  
Surg 399-86 (59629) Graduate Research